Final Progress Report

Project Title: Cold Press Technology for the Production of Extra Virgin Unrefined Vegetable Oils for Nutraceutical, Pharmaceutical, Food and Industrial Lubricants

Contractor Name: Badger Oil Company

WDATCP Contract No. 14095

Project Leader: Bruce Davis and Mark Mueller

Progress report for Period July 1, 1999 to June 30, 2000

Industrial Lubricants

Bicycle Chain Oil Hydrobikes, Inc. Two different chain oils were specifically formulated for a waterbike manufacturer called Hydrobikes, Inc. The company manufactures a chain drive water bike. See attachment. The company has been using synthetic chain oils for two different application in the bike, one for a transmission gear and one for the chain. The bio oils as well as synthetic oil were subjected to an Oscillation, Friction and Wear Test by the Tunap Laboratories of Wolfrathausen, Germany. Badger Oil's two formulations where proven to have far superior lubricity resulting in much lower wear on metal surfaces than the synthetic lubricants. Additionally, the bio oil is non toxic and biodegradable. The two bio oils were tested by Hydrobikes and the viscosity of the transmission oil was increased based on the customers need. The work has resulted in a private labeling agreement with Hydrobikes whereby, Badger Oil will manufacture and bottle the oil for Hydrobikes. This private labeling agreement is expected to generate approximately $30,000 in sales annually. See attached label.

Meyers Boat Company There are at least six other manufacturers of water bike type craft in North America and these companies are being targeted for the bike chain oil. In June a relationship was developed with a second OEM water bike manufacturer, Meyers Boat Company of Michigan, manufacturer of SEA Cycle and Water Bikes. This is expected to be a smaller account than Hydrobikes.

A relationship has been developed with Kevin Meyers of Riverbrook Bike and Ski as a representative for the mountain bike and road bike industry. The US bike chain oil market is estimated at more than $15 million annually. He is helping Badger Oil Company gather industrial intelligence on competitive chain oil products, identify appropriate channels and strategy for introducing a chain oil to the bicycle industry. He has made contact with Trek bicycles and several other bike manufacturers.

Badger Oil's bike chain oil was tested in comparison to four different brand name bike chain oils including Shimano's bike chain oil. Based on the tests by the Tunap Laboratories, Badger Oil's was proven to have far superior lubricity and resulted in substantially less wear than any of the four brand names including Shimano's which is one of the leading chain oils in the market. See attachments.

Quality Bicycle Products, Inc. Based on the superior lubricity characteristics, Badger Oil's chain oil have been introduced to the largest US distributor of bikes and accessories, Quality Bicycle Products based in Minneapolis. Starting in February, Quality began field testing the chain oil in several different environments, in cold climate, hot climate and humid climate. Initial review by Quality field testers were highly favorable, but for one reviewer who complained of a solid deposit buildup on the chain .

After discussions with Quality, several options were pursued including changing the formulation to include a drying agent and use of an applicator which would apply the oil directly to the chain rollers. Badger Oil then began an extensive test of its own using a bike test stand which enabled it to compare solid material build up between five different leading brands. With a slight change in formulation and the addition of a bio type evaporative agent, Badger Oil now has chain lube which not only has far better lubricity than any other leading brand chain oil but also runs cleaner

Negotiation with Quality continue with some initial sales yet in year 2000. Quality envisions capturing 10% or more of the chain oil market in the US and to market the lubes internationally.

Working with Kevin Meyer and with Tessol, the following bio products have been developed and will be marketed to the bicycle industry:

- Mountain and road bike chain lube
- Extreme conditions bike chain lube, higher viscosity
- Degreaser
- Lightweight grease

Tree Harvester Chain Lube This a special formulation of a chain oil designed for high speed mechanical tree harvesters used in the logging industry. Tessol field tested the oil in several machines in Europe during 1999 and has released it for market.

Starting in May Badger Oil began field testing the oil in a machine owned by Triple T Enterprises of Mellon, Wisconsin. After three months of field operation, Thomas Timm, President of Triple T Enterpises reports that the bio oil out performs the competitive petroleum based products. In addition to the biodegradability and environmental benefits, Mr. Timm reports the following productivity benefits.

- Reduced chain sharpening and reduced "down time" for chain replacements
- Extra chain life by as much as 400%

- Less wear on sprockets and bar

See copy of enclosed color brochure entitled BioBuzz, the intended trademark name for the tree harvester "bar and chain lube". .

The results of the field trial work with Thomas Timm will be shared with Oregon Chains Saws, the manufacturer of the saws used in the large tree harvesters both in the US and Europe.

Mr.Timm has expressed an interest in being a distributor of the chainsaw and tree harvester "bar and chain" lubes for Wisconsin, Michigan and Minnesota. An agreement for distributorship is being negotiated.

OtherBio Industrial Lubricants During the contract period, the following other bio lubricants were developed and samples produced::

Degreaser This is a grease solvent which is effective with both petroleum and bio greases. The base material for the degreaser is canola and sunflower. The solvent has been provided to the bicycle industry for testing with initial favorable reviews. The biosolvent is also effective in dissolving waxes and paraffins The solvent will be tested in the coming winter season as a wax remover for skis.

Small Engine Purge Oil This is a specially formulated bio crankcase oil intended to be used by small engine manufacturers to purge metal filings and for initial start up test purposes. Since the engines are run for less than 1 minute, the bio oil is not subjected to high temperatures which can result in oil breakdown and oxidation. Contacts are being made with small engine manufacturers for the purpose of introducing the oil for their use. Badger oil proposes to take back the oil from the engine manufacturer , filter and recycle the oil.

Two Cycle Engine Oil A small amount of two cycle engine oil was produced and placed in several engines for test purposes. Because small engine manufactures tie their engine warranty to use of API certified oils, further commercialization of the two cycle engine is not being pursued at this time.

Nutraceutical and Food Grade Oils The following new fruit oil products were produced: cranberry oil, grape oil, plum oil, raspberry oil, blackberry oil and strawberry oil. The seed for the oils were sourced from Three Lakes Winery, Wollersheim Winery and Northland Cranberries. The seeds are a by product of these firms processing line and most often wind up being a waste product. Several different varieties of cranberry and grape oil were produced and it was found the yield of oil differed for each variety. Several grape varieties yielded almost no oil.

Other new vegetable oils produced are: Styrian pumpkin, Black caraway oil, Meadow Foam and Badgersett Hazelnut Oil. Some small field test plots of Styrian pumpkin were grown by Badger Oil during the summer of 1999 in northwest Wisconsin and again in

2000. This pumpkin is grown in Austria and is considered a gourmet type food oil. The seed was imported and it is believed to be the first time it has been grown in the US. It has a special hull less seed and is high in oil content.

Samples of the cranberry oil, raspberry oil, grape oil, pumpkin and black caraway were sent to Brunswick Laboratories of Waltham Massachusetts for antioxidant analysis. Brunswick lab is the only private lab with the capability to test for Total Antioxidants according to the ORAC procedure developed by the USDA ARS Human Nutrition and Aging laboratory at Tufts University. After some initial work, Brunswick concluded their ORAC procedure would not work on the oils since the procedure is based on materials which are water soluble. Working with the Tufts University group, the two labs developed an entirely new procedure to measure the total antioxidants in insoluble fats and oils. The new procedure is called FRAP, Ferric Reduction Antioxidant Power. See attachments. The oils were also analyzed for vitamin E. See attachment. The Blackberry and Raspberry oils were found to have exceptionally high vitamin E, tocotrienols

The FRAP analysis of the cranberry, grape, raspberry oil and black caraway indicated very high antioxidant levels. Perhaps just as importantly, scientists at the ARS Human Nutrition Lab indicate the human cell may absorb antioxidants more readily from an oil base than water base.

The antioxidants of the meal extract were also analyzed for Black Caraway, Strawberry, Black Raspberry and Blackberry. The ORAC assay for these meal extracts were exceptionally high. Higher than anything before tested.

A continuing relationship is being developed with Brunswick Labs and the ARS Human Nutrition and Aging Labs at Tufts University and the Children's Nutrition Center in Arkansas . Dr. Ronald Prior, the scientist who developed the ORAC assay has expressed an interest in developing a CRADA (Cooperative Research and Development Agreement) with Badger Oil focused on several issues including; identification of the phytochemicals acting as antioxidants in the varoius fruit and vegetable oils, the cell absorbtion efficiency for antioxidants from the cold press fruit and vegetable oils, and the potential for these antioxidants to act as cancer cell inhibitorts and to act for antitumor activity. Dr. James Joseph, Chief Neuroscientist at the Tufts Lab is also interested in testing the "superstar" antioxidants in reversing memory loss and brain damage. It's anticipated that the CRADA agreements will be formally developed in the second half of 2,000.

Development of food grade oils has consisted of a discussion with senior management at Northland Cranberries regarding the potential to use their by product fruit seeds for a line of salad oils which could be introduced in the produce section of grocery stores. Additionally, Dr. Stephen Richter and food consultant Bruce Meents have been contacted and have agreed to undertake preliminary work to evaluate several of the oils for food products.

Bio Fuel Natural Diesel (NADI)

A three year demonstration has been planned and set up with Kuran Powers of Lyndon Station, and FABCO of Madison using the NADI fuel in a Caterpillar tractor, the Challenger 35. The NADI fuel is a patented fuel using cold press vegetable oil with additives. The NADI fuel can be run at 100% strength or as a blend with petroleum based diesel. The technical specifications of the NADI fuel were reviewed by Caterpillar and found to meet their requirements

Four hundred gallons of NADI fuel were produced in 1999 for use in the tractor for field work by Kurin Powers. The NADI fuel was a blend of canola oil, sunflower oil produced by Badger Oil and soybean oil produced by SOYCO of Adams Friendship. Kurin Powers observed more power using the biofuel versus petroleum based diesel, saying he could plow one gear higher.

In the second year of operation an additional 400 gallons of NADI were produced and has been in use for spring plowing and summer field work. After the third year, FABCO will break down the engine and measure for wear.